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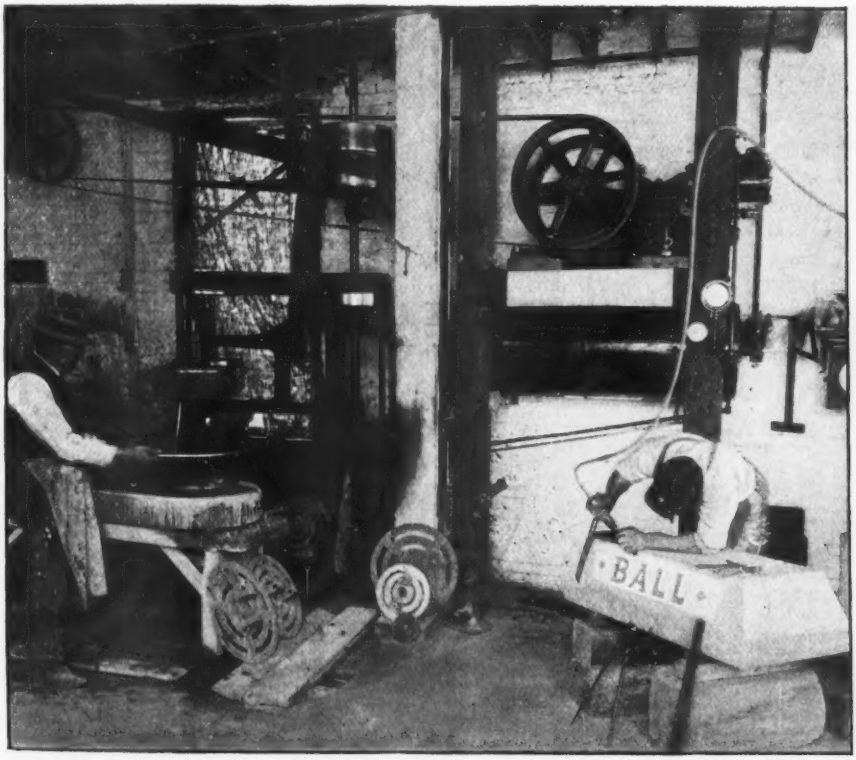
Compressed Air

DEVOTED TO THE USEFUL APPLICATION OF COMPRESSED AIR.

VOL. I. NEW YORK, NOVEMBER, 1896. No. 9



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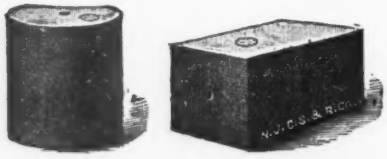

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Compressed Air

A MONTHLY PUBLICATION DEVOTED TO THE USEFUL APPLICATION OF COMPRESSED AIR.

W. L. SAUNDERS, - - Editor and Publisher
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F. C. WEBER, }

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We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

All communications should be addressed to COMPRESSED AIR, 26 Cortlandt St., New York.

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Those who fail to receive papers promptly will please notify us at once.

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VOL. I. NOVEMBER, 1896. NO. 9.

It is usually a waste of time to try and engage the average man in a serious discussion on some feats in engineering performed by the ancients.

The impression is general among engineers and others that the Colossus of Rhodes, for instance, could not have been put up in the manner we are told, and if put up it would not stand the wind pressure, etc., and they are ready to prove it by rules of modern science.

Many marvelous achievements and inventions of the ancients are simply discredited because we are not able to do the same to-day. History, however, is authentic enough to convince us that some things have been forgotten, and that although we are far in advance of the ancients in science and the arts generally, still there are specific instances in which they were our superiors.

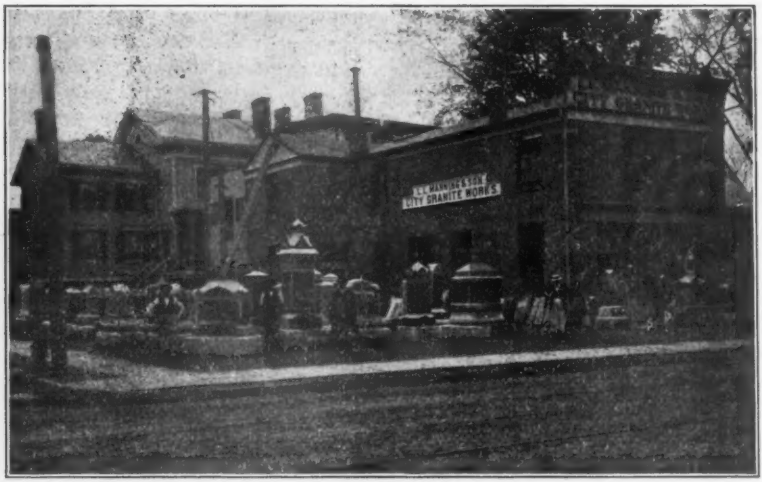
In this age of invention of labor-saving devices and improved appliances for our personal comfort, we are only too ready to attribute everything to the spirit of the times, and we are quite surprised to find that something new, as we are pleased to call it, is really something old, and something very old at that. Take the subject of the two sketches on another page; one represents a view of the new air beds on the sleeping cars which have become prominent of late since the railroad men have taken such a fancy to compressed air.

The air bed is not of modern origin. It was known to the ancients, as will be observed from the cut shown in another column of this issue, copied from some figures attached to the first German translation of Vegetius, A. D. 1511. It represents soldiers reposing on them in time of war, with the mode of inflating them by bellows.

Heliogabalus used to amuse himself with the guests he invited to his banquets by seating them on large bags or beds, "full of wind," which being made suddenly to collapse, threw the guests on the ground.

Although this case in point does not rival in importance the Colossus of Rhodes or Curios' Amphitheatre, holding 80,000 persons and built so as to swing about in the course of a few hours and form two theatres back to back, still it might serve to answer the question, What is new in the world?

Much agitation seems to prevail in the minds of electric motor people upon the appearance of the Hardie Compressed Air Motor, and the work it is doing on the Third Ave. Street Railway in New York. Articles have appeared in various electrical journals, in which endeavor is made to throw cold water on the invention. Electricity has had a lion's share of trials, and has been generously patronized. Give the Air Motor a fair chance.



A MODERN STONE YARD.

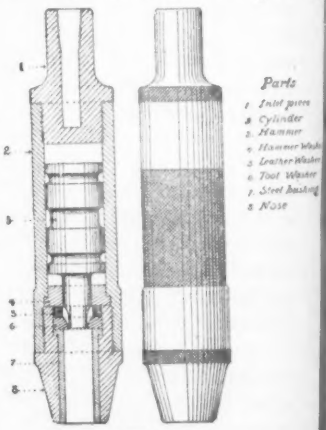
Carving and Dressing Stone.

COMPRESSED AIR is enabled to present on its cover a picture of the interior of a stone manufacturing plant that is operated by compressed air. The view was taken in the shop of L. L. Manning & Son, of Plainfield, N. J., and it illustrates what is being done in this important line by pneumatic tools and other improved apparatus. For dressing and carving granite, marble or other material used as monuments and grave decorations, there is nothing so effective for the purpose, and experience proves that it reduces the cost of producing handsome designs so that the purchase of suitable gravestones is within the reach of all.

The plant of Manning & Son consists of one vertical boiler and Baxter engine, a 6-in. x 6-in. Class "E" Ingersoll-Sergeant Compressor, one polishing machine, and a set of pneumatic tools of the Keller pattern. The whole outfit was supplied by the C. H. Haeseler Co., of Philadelphia, Pa. The arrangement of the plant was planned by the owners, and for economy of space, convenience, and in general appearance, it appears to be admirable.

The compressor is run by belt. It takes 60 pounds of steam to run the entire plant, and about 40 pounds of air pressure to run the pneumatic tools on heavy work.

With the polishing machine, a piece of granite, 6 ft. x 6 ft., can be dressed and polished in two and one-half days. By



PNEUMATIC TOOL.

hand it is said that it would take at least one month to do it.

One pneumatic tool in the hands of a competent operator will do as much as three men, and do it much better. It can trace and cut letters, and do all sorts of fancy work. A stone-worker having such a plant as the one described has every chance of success, and can certainly distance competitors in time and cost.

Dudley's Air Gun.

It has been found that compressed air is the safest and best agent for expelling a dynamite shell.

The "Scientific American," in a recent issue, describes the Dudley gun, a gun and compressed air plant in itself. It certainly is a most ingenious arrangement, and its use of gunpowder for the purpose of compressing air opens up possibilities in the application of the principle which will be apparent to any skilled mechanic.

The Dudley gun might be called a long tube, bent upon itself so as to show three tubes side by side. These tubes lie parallel to each other. The long central tube is the firing tube, and weighs 250 pounds in a 4-inch gun.

The two side tubes might be called the air compressor, for it is in them that the air is compressed to 850 pounds to the square inch. At the forward end of the gun, the two outside tubes are connected by an air passage.

The rear end of one of the tubes is connected by a similar passage to the central or firing tube, and the rear end of the other side tube is fitted with a suitable breech mechanism to receive the powder cartridge. A glance at the diagram will show the passage of the air when the powder is ignited.

The central or firing tube has a breech mechanism similar to a breech-loading rifle. In this the projectile with its load of high explosive is placed. Then the breech piece is locked, the powder cartridge is placed in the side tube, and its breech is locked.

The powder is ignited, and the air in the tubes is compressed by the generate gases.

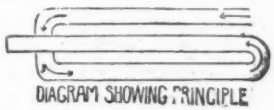
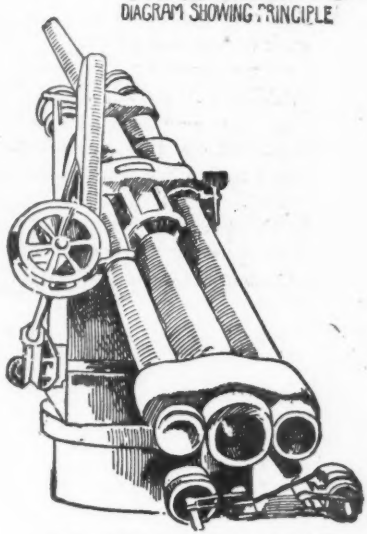


DIAGRAM SHOWING PRINCIPLE



DUDLEY PNEUMATIC GUN.

The force of the explosion, cushioned by the two columns of air which are between the powder cartridge and the projectile, acts upon the projectile. The shell leaves the gun with little noise of explosion and no smoke whatever.

The recoil of the gun is slight, and springs are provided for taking it up. The projectiles used in the gun are brass cylinders with pointed ends. The fuse is attached to the front end and from the rear end of the shell extend vanes or rings to insure rotation. The entire shell is 52 inches long, and when fully charged weighs 32 pounds.

In the main body of the shell, which is the brass cylinder, the dynamite or nitroglycerine is placed. In the forward end

of the charge is placed a charge of gun cotton, and in the centre of the gun cotton is a case containing fulminating mercury.

It is believed that the principle of compressing air by the explosion of gunpowder, as it is done in the Dudley gun, can be employed in the useful arts, particularly in quarrying and tunnel work, where air drills are remote from the main pipe of the air compressor plant.

WATER AND AIR.

An all-important question, nowadays, is how to secure an adequate and wholesome supply of water. It interests the manufacturer, the farmer and the water committees of both large and small communities. Its importance cannot be over-estimated.

Until within a few years the supply taken from surface streams was considered sufficient, but droughts and ever-present impurities have shown the necessity for a more careful study of the subject, and as a result we have heard from all sections the decision to bore through the crust of the earth and tap the subterranean streams which are known to exist almost everywhere. Sometimes this water-bearing strata has been found within 20 or 30 feet of the surface, as, for instance, on Long Island. And again, it has become necessary to bore 1000 to 2000 feet, as is the case quite often in Texas.

The water secured from these underground sources is more wholesome and less apt to be contaminated than that taken from surface streams, and this is because the sand and gravel through which it percolates acts as a filter more effectually than any device patented by human being. Whenever it is reported that this or that town's water is impure and dangerous to public health, it will be found that the source of supply is a surface stream, and seldom, if ever, do we hear of sickness caused by water derived from underground sources.

After having drilled the well and tapped the subterranean stream, the problem seems to be how to bring the water to the surface; for as a rule the well does not flow of its own accord. Deep well pumps of innumerable patterns and designs have been constructed, and while each claims to be better than the other, they all seem to have their drawbacks. Their capacity is always limited, they require power out of all proportion to the work performed, and seem to have a faculty for getting out of order at the wrong moment; the cause usually being that a rod has been either broken or bent, or a valve or plunger become worn. All of this entails endless expense and annoyance, and makes the problem more serious than at first thought.

When the water level in the well rises within suction reach, a piston pump is usually employed; and while there are a great many good makes on the market, the same objection is applicable to them as to the deep-well plunger type, and should the water level drop more than 25 or 28 feet below the surface, they become useless.

The problem seems to have been solved, however, by what is known as "The Air Lift" system—that is, raising water by means of compressed air. It was patented in 1892 by the late Dr. Julius G. Pohle. His process is a novel one, because it does away with all moving parts in the well, such as valves, rods, plungers, etc. Needless to say, his claim of "simplicity" is borne out and its economy and value are attested to by its adoption throughout the country by large numbers of Water-works and manufacturing establishments.

The process consists of placing two properly proportioned pipes in the well, one for discharging the water at the surface or tank, and the other for conveying the air into the well. These two pipes are connected at the bottom by what is commonly known as a foot or end piece, the air pipe being connected at the other end to the air compressor.

The compressed air is then forced through the air pipe into the foot piece and water pipe. and by its inherent expansive force, layers or pistons of air are formed in the water pipe, which lift and discharge the layers of water through the end of the water discharge pipe at the surface or tank.

At the beginning of the operation, the water surface outside of the pipe and the water surface inside of the water pipe are at the same level; hence the vertical pressure per square inch are equal at the submerged end of the pipe, outside and inside. As the compressed air is forced into the lower end of the water pipe, it forms alternate layers with the water, so that the pressure per square inch of the column thus made up of air and water, as it rises inside of the water pipe, is less than the pressure per square inch outside of the pipe.

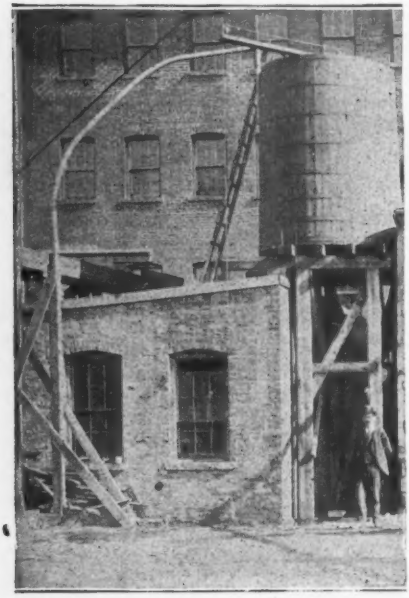
Owing to this difference of pressure, the water flows continually from the outside to within the water pipe by gravity force, and its ascent through the pipe is free from shock, jar, or noise of any kind.

These air sections, or strata of compressed air, form water-tight bodies, which in their ascent in the act of pumping, permit no "slipping" or back-flow of water. As each air stratum progresses upwards to the spout, it expands on its way in proportion as the overlying weight of water is diminished by its discharge, so that the air action, which may have been, say 50 lbs. per square inch at first, will be only 1.74 lbs. when it underlies a water layer of four feet in length at the spout, until finally this air section when it lifts up and throws

DR. JULIUS G. POHLE.

out this four feet of water, is of the same tension as the normal atmosphere; thus proving that this pump is a perfect expansion engine.

As the weight of the water outside of the discharge pipe (the head) is one-third greater per square inch than the aggregate water sections within the pipe when in operation, it follows that the energy due to this one-third greater weight is utilized in overcoming the resistance of entry into the pipe, and all the friction within it.



RAISING WATER BY THE POHLE AIR LIFT AT H. LANG CO.'S FACTORY NEWARK, N. J.

A peculiar and very important feature of the "Air Lift" system is that it invariably increases the yield of the well from two to three times. At a recent test made by the City of Bethlehem, Pa., the yield of a well which was normally at the rate of 200 gallons per minute, was increased to 627 gallons per minute, or just three times, which is something remarkable.

In breweries it is desirable that the water be at as low a temperature as possible, and quite a number have installed Air Lifts because of the fact that the water raised by this system has been reduced as much as two degrees in temperature. This is ascribed to the expansion of the air abstracting the heat from the water with which it is in close contact.

Prof. Thos. M. Drown of the Lehigh University, some time ago stated that the success of filtration is very largely dependent upon aeration. It is claimed that this is accomplished in a great degree by the Pohle system, and is no doubt true, as the air sweeping through the water mechanically scrubs and cleanses it.

The value and advantages of Dr. Pohle's system are just becoming known, and the day is not far distant when it will be universally adopted:

Because of its simplicity.

Because of its economy.

Because it pumps all the water the well will yield.

Because of its tendency to increase the yield of the well.

Because it aerates and purifies the water.

Because with one compressor any number of wells can be pumped.

Because it cools the water.

H. HELLMAN.

The Pelton Water Wheel Company of San Francisco have recently furnished the Alaska Gold Mining Company of Douglass Island, Alaska, a wheel of such extraordinary dimensions as to make a brief description of interest.

The wheel is 22 feet in diameter, and is connected directly to the shaft of a Duplex Compressor, with air cylinders 24 inches in diameter by 38 inch stroke, having a capacity of delivering 2,800 cubic feet of free air per minute at a pressure of 80 lbs. per square inch.

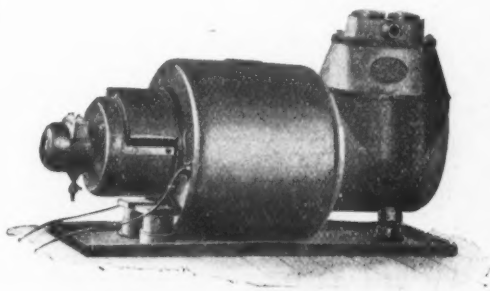
The wheel weighs 25,000 lbs., and serves the purpose of a fly-wheel as well as prime mover. It runs under a water head of 480 feet at a speed of 75 revolutions, and developes upwards of 500 H. P.

A hydraulic speed regulator is attached to the wheel, which controls its movement so that a uniform air pressure is maintained on the receiver.

A Diminutive Air Compressor.

An air compressor 12 inches high, 15 inches wide and 23 inches long, and actuated by electricity, is a real thing, and not a mere plaything or curiosity. It is in practical use and doing service on electric cars to control the brakes. It is installed under the ordinary car seat, and if it is run for 30 seconds it will compress enough air to stop the car half a dozen times.

The Standard Air Brake Co. build these compressors in connection with their air brakes, and they are as complete as the full-grown compressor used for heavier work.



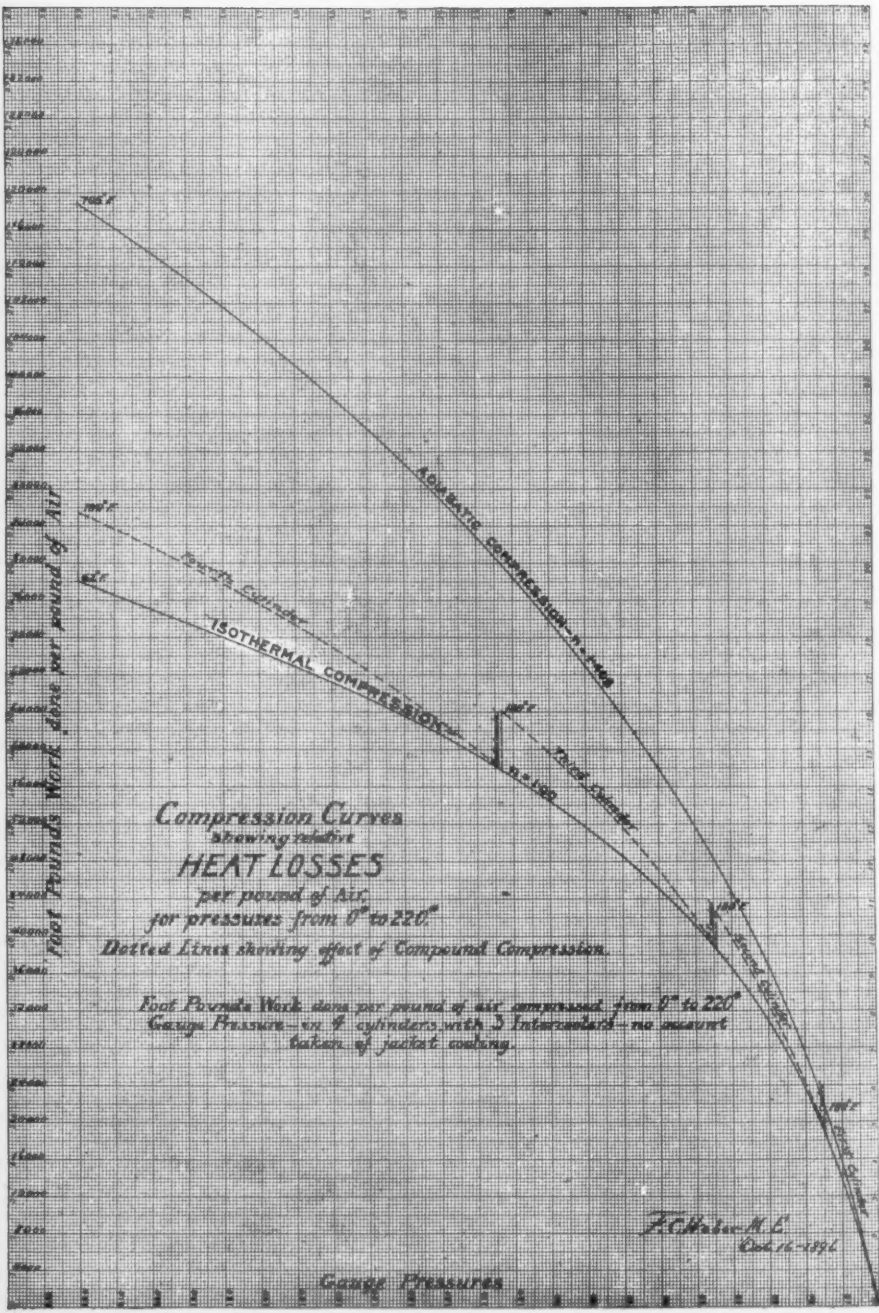
A DIMINUTIVE AIR COMPRESSOR.

While the compressor is now used in connection with air brakes exclusively, its field of usefulness could be enlarged to a very great extent.

There are many places where compressed air would be used, were it available, and this little compressor and others of its kind might be profitably employed; such as in pneumatic dispatch tubes, in pottery work for spraying colors, operating small pumps and dental tools, and innumerable other purposes.

At the Altoona shops of the Pennsylvania Railroad the problem of handling ashes from locomotives has been satisfactorily solved by the erection of several pneumatic ash-hoists. An iron frame resembling a gallows extends across three tracks. Under it there is an ash pit. The bottom of this pit has a narrow-gauge track on which small trucks run and carry what may be called bifurcated buckets to receive the ashes as they are removed from the ash-pans of the engines. The ashes are raked out of the ash-pan into these buckets. The buckets are then attached to the suspended hoist and run upon a trolley the length of the frame and dumped into a car.

The Metropolitan Traction Co. have made several tests of the Hoadley Motor on their Lenox Avenue line, New York. The line is now equipped with the underground trolley, and the compressed air car has been running under the same condition as the other cars on this busy line. For nearly three weeks it made regular trips, carrying passengers as the other cars did, without the public knowing it. The cars are exactly the same as the standard cars of the company. The air motors are small engines enclosed in boxes and geared to the axles precisely as the electric motors are, and are but little heavier. The receivers are charged to about 2,000 pounds pressure, and the air is reheated before using.


Compression Curves
Shewing relative
HEAT LOSSES
per pound of Air
for pressures from 0° to 220°
Dotted Lines shewing effect of Compound Compression.
Foot Pounds Work done per pound of air compressed from 0° to 220°
Gauge Pressure – ex 4 cylinders with 3 Intercoolers – no account
taken of jacket cooling.
ADIABATIC COMPRESSION n = 1.408
Fourth Cylinder
ISOTHERMAL COMPRESSION
n = 1.00
Third Cylinder
Second Cylinder
First Cylinder
F. C. Hale. M. E.
Oct. 16 - 1894
Gauge Pressures
Foot Pounds per pound of Air

The Dancing of the Air.

And now behold your tender nurse, the Air,
And common neighbor, that aye runs around;
How many pictures and impressions fair
Within her empty regions are there found,
Which to your senses dancing do propound!
For what are breath, speech, echoes, music, winds,
But dancings of the air in sundry kinds?

For when you breathe, the air in order moves—
Now in, now out, in time and measure true;
And when you speak, so well she dancing loves,
That doubling oft, and oft redoubling new,
With thousand forms she doth herself endue:
For all the words that from your lips repair
Are naught but tricks and turnings of the air.

Hence is her prattling daughter, Echo, born,
That dances to all voices she can hear;
There is no sound so harsh that she doth scorn,
Nor any time wherein she will forbear
The airy pavement with her feet to wear;
And yet her hearing sense is nothing quick,
For after time she endeth every trick.

And thou sweet Music, dancing's only life,
The ear's sole happiness, the air's best speech,
Loadstone of fellowship, charming rod of strife,
The soft mind's paradise, the sick mind's leech,
With thine own tongue thou trees and stones can teach,
That when the air doth dance her finest measure,
Then art thou born, the God's and men's sweet pleasure.

Lastly, where keep the winds their revelry,
Their violent turnings, and wild whirling hays,
But in the airs' translucent gallery?
Where she herself is turned a hundred ways,
While with those maskers wantonly she plays
Yet in this misrule, they such rule embrace,
As two at once encumber not the place.

SIR JOHN DAVIES.

A Clock by Air.

The new Fisher Building in Chicago is furnished with a clock run by compressed air. It is a monster time-piece on the 18th floor, and sets the hands on numerous dials throughout the building. This great clock is a sort of central plant, and it controls almost any number of secondary clocks or dials. Compressed air forms the connection between them. An air pressure of about fifteen pounds to the square inch is required, and that is usually obtained from a small air pump where other compressing apparatus are not available.

When the air pressure is turned on in the main pipe it exerts its pressure all over the building. At each dial there is a little air pocket, a simple escapement, and a couple of gear wheels. When the air pressure fills the pocket, the escapement starts and the hands move ahead one minute. Then the air is exhausted, the pocket empties, and the escapement sets itself ready for another impulse. In this way each minute sets the dials all telling the correct time according to the master clock. Hence the secondary timepieces are never more than thirty seconds wrong, either fast or slow.

In the Fisher Building there are now about twenty-five of these dials in use, and more are being added as fast as tenants arrive.

As another instance of the dependence of electricity on compressed air, and vice versa, we might mention rock blasting. One of the most notable illustrations of this is shown in the building of the Chicago Drainage Canal. James Macbeth & Co., New York, manufacture machines that are used extensively on this great work. They are complete in themselves, being capable of firing from 10 to 50 holes at once, according to size of machine used. The holes are bored in the rock by compressed air drills. As many as 26 are bored transversely across the canal, and by the operation of the electric blasting machine they are fired simultaneously. These blasts were the most impressive sights on the canal.

The Foster Air Pressure Regulator.

Mr. J. M. Foster, inventor of the valve that bears his name, is President and General Manager of the Foster Engineering Company of Newark, N. J. Years ago he

invented and patented several devices for the use of compressed air and gases in the arts and industries, especially in dental surgery and in lighting systems. Since then his researches have extended into the wider fields of regulation of all pressures of air, steam, gas and water. As a practical result of his scientific and mechanical skill, the Foster Pressure Regulator was evolved—a valve that to-day holds the highest place for all-round efficiency of any in the market.

On the merits of his Regulator the large business of the Foster Engineering Company was founded, and the company has become the leading manufacturers of pressure regulating valves in this country.

The Foster Regulator is now the standard of the United States Navy, the Government employing it exclusively on its cruisers, battleships, and other vessels, while the leading shipbuilders of the country have adopted it as the best pressure regulator made.

When the application of compressed air as a motive power for street and other railways assumed commanding importance and promised commercial returns, the most difficult problem was to bring the high pressures under quick and absolute control of the motorman. Various devices were tried to effect this, but all proved more or less inadequate, until the Foster valve was introduced. With some modifications necessary to the new service, this valve was found to answer every requirement—in fact, to be the only one that would; and it is not too much to say that without it the practical success of compressed air motors would still be a matter of doubt.

The Foster valve is now used in the Hardie, Hoadley, Porter and other systems.

We hope in an early number to present an illustrated description of this valve, and the function it serves in connection with compressed air motors.

The following was taken from a letter to Mr. H. U. Frankel, President of the Moran Flexible Steam Joint Co., from E. P. Lord, Sup't. of H. K. Porter & Company :

" Replying to the last paragraph of your letter of the 9th inst., regarding the service that we have secured from the use of the Moran Joint : For your information we would state that with the increasing demand and orders for compressed air locomotives with which we have been favored in recent years, we were compelled to adopt some form or design of metallic coupling which would be absolutely safe and tight under the excessive air pressures of 600 to 800 pounds per square inch which were required in charging our pneumatic motors. We were unable to secure any rubber hose used in connection with our couplings that would secure to us the life and safety in operation that was essential. In the selection of the Moran Joints, as manufactured by your company, however, we believe that we have secured a coupling which will give us the most satisfactory service and meet our specifications as to tightness, safety, flexibility and durability, as the couplings we have already used in the installation of compressed air plants have so far never given us the slightest trouble."

IN THE TWENTIETH CENTURY.

COMPRESSED AIR.

(CONTINUED.)

Fig. 13 illustrates the theory of Duplex Air Compressors. The hydraulic piston or plunger compressor is largely used in Germany and elsewhere on the Continent of Europe, but the duplex may be said to be the standard type of European compressor at the present time. It is also largely used in America. Fig. 13 shows the four cylinders of a duplex compressor in two positions of the stroke. It will be observed that each steam cylinder has an air cylinder connected directly to the tail rod of its piston, so that it is a direct-acting air cylinder is beginning its stroke. Referring now to the lower section, it will be seen that the conditions are reversed. One crank has turned the center, and that piston which in the upper section was doing the greatest work is now doing little or nothing, while the labor of the engine has been transferred to those cylinders which a moment before had been doing no work.

This is the theory of the Duplex Compressor, but it can hardly be said to be true when applied in practice, because of the heavy fly wheel which is placed on the main shaft. This wheel takes up and equalizes the power imparted by the steam pistons, and in fact it is the fly wheel which really does the work of compression at or

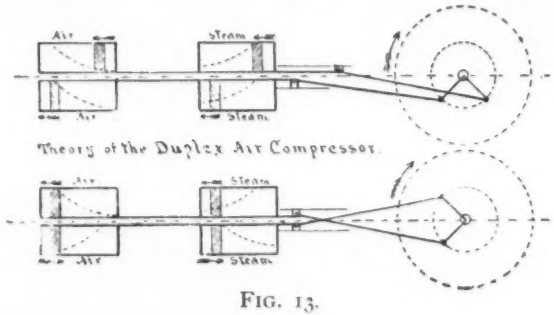


FIG. 13.

machine, except in that the strains are transmitted through a single fly wheel, which is attached to a crank shaft connecting the engines. In other words, a duplex air compressor would be identical with a duplex steam engine, except in, that the air cylinders are connected to the steam piston rods. The result is, as shown in Fig. 13, that at that point of the stroke indicated in the top section, the upper right hand steam cylinder, having steam at full pressure behind its piston, is doing work through the angle of the crank shaft upon the air in the lower left hand cylinder. At this point of the stroke the opposite steam cylinder has a reduced steam pressure and is doing little or no work, because the opposite near the end of each stroke. Heavy fly wheels are therefore essential in order to produce the best results with duplex compressors.

In the duplex pattern, the crank shafts being set quartering, as is the usual construction, the engine may be run at low speed without getting on the center. Each half being complete in itself, it is possible to detach the one when only half the capacity is required.

Commercially the Duplex Compressor appeals to the trade in that one side, or a half duplex, is furnished with a fly wheel and outboard bearings designed for a complete duplex machine, so that at first, at a little more than half the expense, one side

is erected and when more air is needed the capacity of the plant is doubled by adding the other half. Where large capacities are required the duplex will admit of larger air production with economical engines, and at less expense when the cost of the plant is considered in proportion to the volume of air furnished.

Mr. John Darlington, of England, gives the following particulars of a modern air compressor of European type:

"Engine, two vertical cylinders, steam jacketed, with Myer's expansion gear. Cylinders, 16.9 inches diameter, stroke 39.4 inches; compressor, two cylinders, diameter of piston 23·0 inches; stroke 39·4 inches; revolutions per minute, 30 to 40; piston speed, 39 to 52 inches per second; capacity of cylinder per revolution, 20 cubic feet; diameter of valves, viz., four inlet and four outlet, 5½ inches; weight of each inlet valve, 8 lbs.; outlet, 10 lbs.; pressure of air, 4 to 5 atmospheres. The diagrams taken of the engine and compressor show that the work expended in compressing one cubic meter of air to 4·21 effective atmospheres was 38,128 lbs. According to Boyle and Mariotte's law it would be 37,534 lbs., the difference being 594 lbs., or a loss of 1·6 per cent. Or if compressed without abstraction of heat, the work expended would in that case have been 48,158. The volume of air compressed per revolution was 0·5654 cubic meters. For obtaining this measure of compressed air, the work expended was 21,557 pounds.

"The work done in the steam cylinders, from indicator diagrams, is shown to have been 25,205 pounds, the useful effect being 85½ per cent. of the power expended. The temperature of air on entering the cylinder was 50 deg. Fah.; on leaving, 62 deg. Fah., or an increase of 12 deg. Fah. Without the water jacket and water injection for cooling the temperature it would have been 302 deg. Fah. The water injected into the cylinders per revolution was 0.81 gallons."

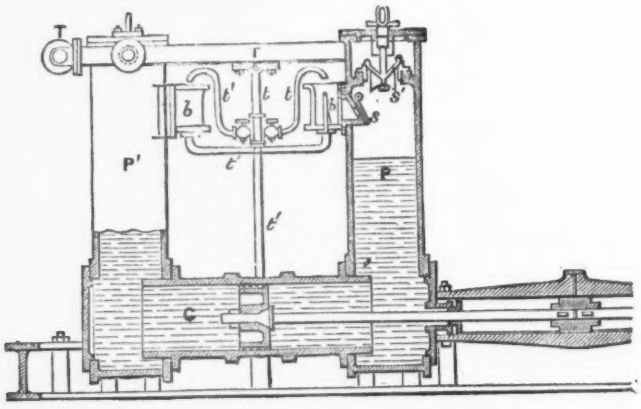


Fig. 14.— Hydraulic Air Compressor.

We have in the foregoing a remarkable isothermal result. The heat of compression is so thoroughly absorbed that the thermal loss is only 1·6 per cent.; but the loss *by friction of the engine* is 14·5 per cent., and the net economy of the whole system is no greater than that of the best American dry compressor, which loses about one-half the theoretical loss due to

heat of compression, but which makes up the difference by a low friction loss.

The wet compressor of the second class is the water piston compressor, Fig. 14.

The illustration shows the general type of this compressor, though it has been subject to much modification in different places. In America a plunger is used instead of a piston, and as it always moves in water, the result is more satisfactory. The piston, or plunger, moves horizontally in the lower part of a U-shaped cylinder. Water at all times surrounds the piston and fills alternately the upper chambers. The free air is admitted through a valve on the side of each column and is discharged through the top. The movement of the piston causes the water to rise on one side and fall on the other. As the water falls the space is occupied by free air, which is compressed when the motion of the piston is reversed, and the water column raised. The discharge valve is so proportioned that some of the water is carried out after the air has been discharged. Hence there are no clearance losses.

The chief claim for this water piston compressor is that its piston is also its cooling device, and that the heat of compression is absorbed by the water. So much confidence seems to be placed in the isothermal features of this machine that usually no water jacket or spray pump is applied. Mr. Darlington, who is one of the stanch defenders of this class of compressors, has found it necessary to introduce "spray jets of water immediately under the outlet valves," the object of which is to absorb a larger amount of heat than would otherwise be effected by the simple contact of the air with the water-compressing column. Without such spray connections, it is safe to say that this compressor has scarcely any cooling advantages at all, so far as air cooling is concerned. Water is not a good conductor of heat. In this case only one side of a large body of air is exposed to a water surface, and as water is a bad conductor, the result is that a thin film of water gets hot in the early stage of the stroke, and little or no cooling takes place thereafter. The compressed air is doubtless cooled before it gets even as far as the receiver, because so much water is tumbled over into the pipes with it; but to produce economical results, the cooling should take place *during compression*.

Water and cast iron have about the same relative capacity for heat at equal volumes. In this water piston compressor we have only one cooling surface, which soon gets hot, while with a dry compressor, with water jacketed cylinders and heads, there are several cold metallic surfaces exposed on one side to the heat of compression, and on the other to a moving body of cold water.

But the water piston advocate brings forward the question of speed. It is said that, admitting that the cooling surfaces are equal, we have in one case *more time* to absorb the heat than in the other. This is true, and here we come to an important class division in air compressing machinery *high speed and short stroke* as against *slow speed and long stroke*. Hydraulic piston compressors are subject to the laws that govern piston pumps, and are, therefore, limited to a piston speed of about 100 feet per minute. It is quite out of the question to run them at much higher speed than this without shock to the engine and fluctuations of air pressure due to agitation of the water piston. The quantity of heat produced—that is, the degree of temperature reached—depends entirely upon the conditions in the air itself, as to density, temperature and moisture, and is entirely independent of speed. We have seen that it is possible to lose 21·3 per cent. of work when compressing air to five atmospheres without any cooling arrangements. With the best compressors of the dry system one-half of this loss is saved by water jacket absorption, so that we are left with

about 11 per cent., which the slow moving compressor seeks to erase. We are quite safe in saying that the element of *time alone* in the stroke of an air compressor could not possibly effect a saving of more than half of this, or 5½ per cent. Now, in order to get this 5½ per cent. saving, we reduce the speed of an air-compressing engine from 250 feet per minute to 100 feet per minute. We must, therefore, in one case have a piston area *three and one-half* times that of the other in order to get the *same capacity of air*, and in doing this we build an engine of enormous proportions, with heavy moving parts. We load it down with a large mass of water, which it must move back and forth during its work, and thus we produce a percentage of friction loss alone equal to twice or even three times the 5½ per cent. heat loss which is responsible for all this expense in first cost and in maintenance, but which really is not saved, after all, unless water injection in the form of spray also forms a part of the system.

It is obvious that cost of construction and maintenance have much to do with the commercial value of an air compressor. The hydraulic piston machine not only costs a great deal more in proportion to the power it produces, but it costs more to maintain it, and it costs more to run it. It is not an uncommon thing to hear engineers speak of the hydraulic piston compressor as the "most economical" machine for the purpose, but that it is so "expensive" and takes up so much room, and requires such expensive foundations that, unless persons are "willing to spend so much money," they had better take the next best thing, a high speed machine.

The hydraulic piston compressor has one solitary advantage, and that is, it has no dead spaces. It was conceived at a time when dead spaces were very serious conditions. Valves and other mechanism connected with the cylinder of an air compressor were once of such crude construction that it was impossible to reduce the clearance spaces to a reasonable point, and furthermore, the valves were heavy and so complicated that anything like a high speed would either break them or wear them out rapidly, or derange them so that leakages would occur. But we have now reduced inlet and discharge valves and all other moving parts connected with an air cylinder to a point of extreme simplicity. Clearance space is in some cases destroyed altogether by what is, as it were, an elastic air head which is brought into direct contact with the piston. All this reduces clearance to so small a point that it has no influence of any consequence. The moving parts are made extremely simple.

W. L. SAUNDERS.

Mannesmann Steel Bottle Test.

The public in general appears to have the idea that using compressed air stored at high pressures on street cars is dangerous. To prove how unfounded is this view, one of the bottles or tubes that is used in street cars was tested to destruction by hydraulic pressure on the 10th inst. by Chas. G. Eckstein & Co. of New York, at the works of Messrs. Watson & Stillman, of this city. Prof. Jacobus, of Stevens Institute, assisted by Mr. Curtis W. Shields of our staff, conducted the test, the results of which are given below. Among those interested present were Mr. Alfred Mannesmann, president of the Mannesmann Cycle Tube Co., Adams, Mass.; Frank Richards, of the "American Machinist;" John J. McCutcheon, Ass't Engr. American Air Power Co.; Rudolph Allert, Sup't Consumers Brewing Co. and Dr. Wm. Mettenheimer.

The bottle was marked off into 7 equal parts and the measurements taken without pressure beginning at the bottom, were as follows: 2′ 5 1-16″, 2′ 5 1-16″, 2′ 5 1-16″, 2′ 5⅛″, 2′ 5 3-32″, 2′ 5 3-32″, 2′ 5 1-32″ outside diam. respectively. Length 5′ 6⅛″ over all between perpendiculars.

Under a pressure of 2500 lbs. the greatest expansion was a little over 1-16″; at 4000 lbs. 3-32″. When this pressure was removed the bottle returned to its original measurements. At 4350 lbs. the greatest expansion was ⅛″; at 4550 lbs. 7-32″, and the greatest permanent set noticed was 6-32″.

At 5000 lbs. the length of the bottle had increased nearly ⅛″, and the expansion was 7-16″; at 5280 lbs. ⅜″, at 5730 lbs. 13-16″. The bottle burst under a pressure of 5760 lbs. The fracture was very clean, and not even a minute particle of the metal flew. The fracture extended from the neck a distance of 2′ ¾″ down the side of the bottle.

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The private car of the vice-president of the Pittsburg and Lake Erie Railroad is equipped with the Ruth pneumatic mattresses and chair seats. These appliances are contained in one compartment of the car, and consist of four sections, or eight single beds, furnished with eight heavy duck and rubber mattresses that can be inflated with air from the engine by simply turning the air-cock provided near each bed.

When not in use, and the compartment is being used as a parlor, they are entirely out of the way and one would not even suspect them of being a part of the furnishings of the car, When not inflated they shut up like an accordion, being formed in pleated folds, and fit into the side of the car and are covered from sight by the piece forming the side of the beds.

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The partitions dividing the berths are fitted closely to the inside wall of the car, the portions of the partition that would cover the car windows being cut away. These partitions are fitted with shutters windows sliding vertically, and can be opened or closed as desired. If closed they cannot be opened by the occupant of the berth. When opened in either the lower or upper section the two sections have free communication, and this arrangement is desirable in case of sickness or for families with children. The operation for transforming the parlor to a sleeping compartment is simple and easy. The porter by turning the same air valve that inflates, siphons the air from the seats of the chairs and then turns their backs down, making them low enough to fit under the bottom berths.

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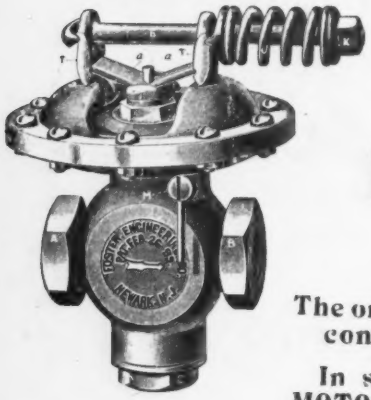

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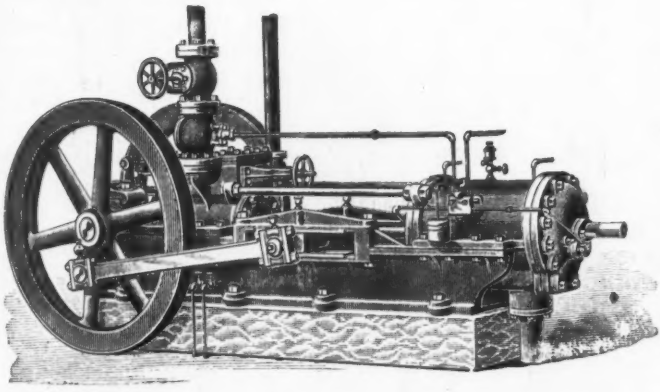

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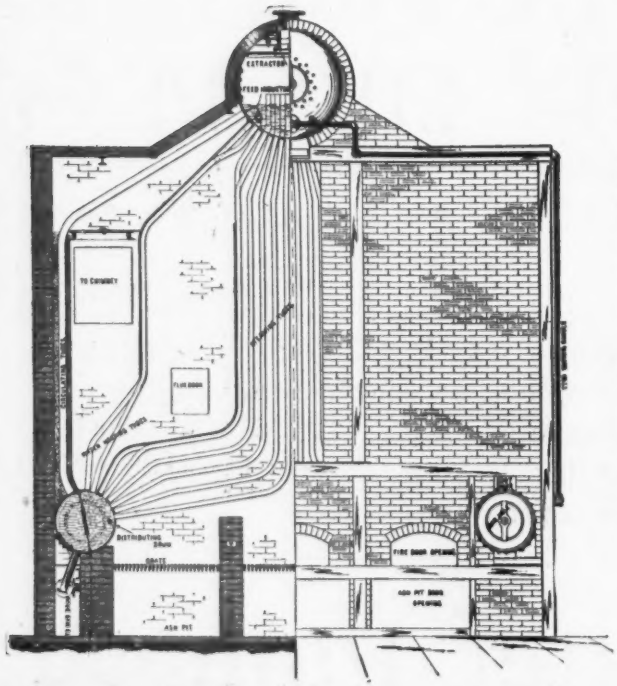

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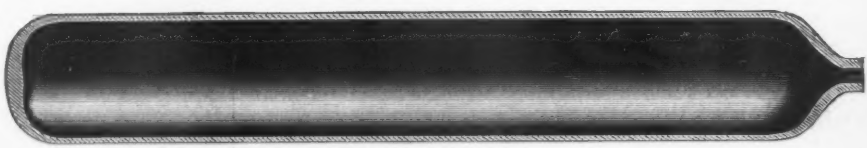

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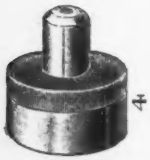

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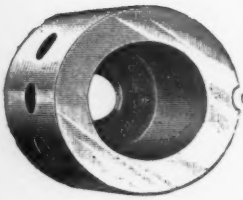

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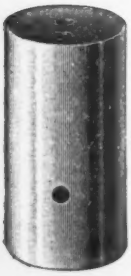

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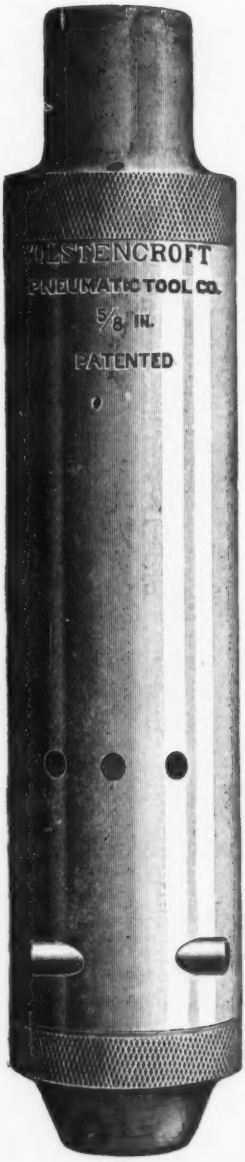

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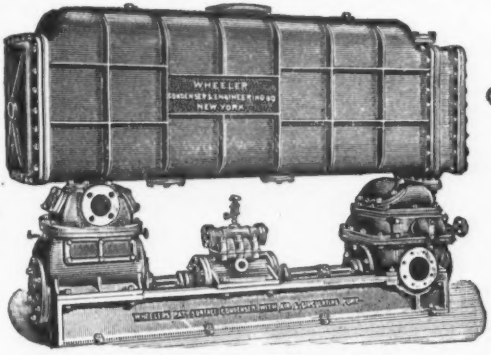

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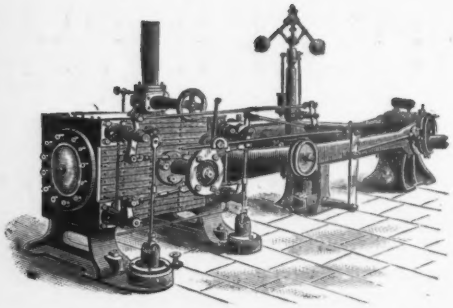

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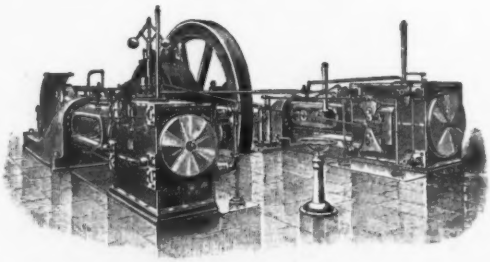

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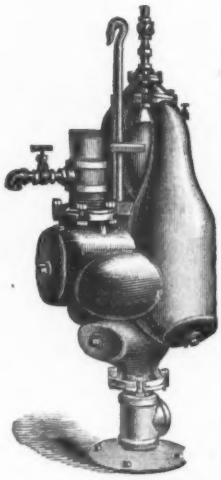

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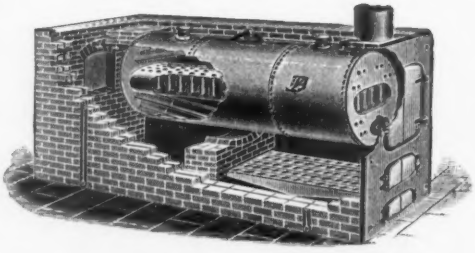

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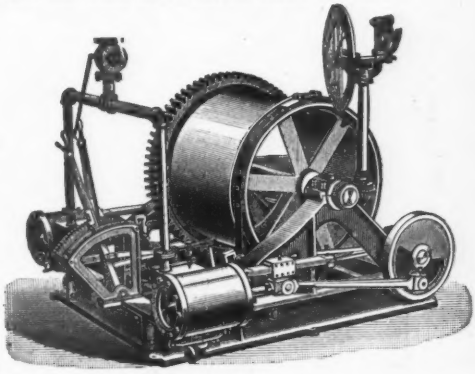

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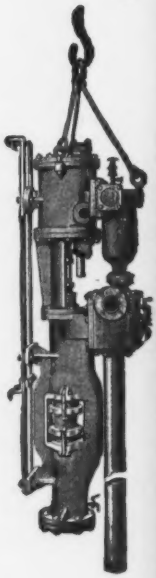

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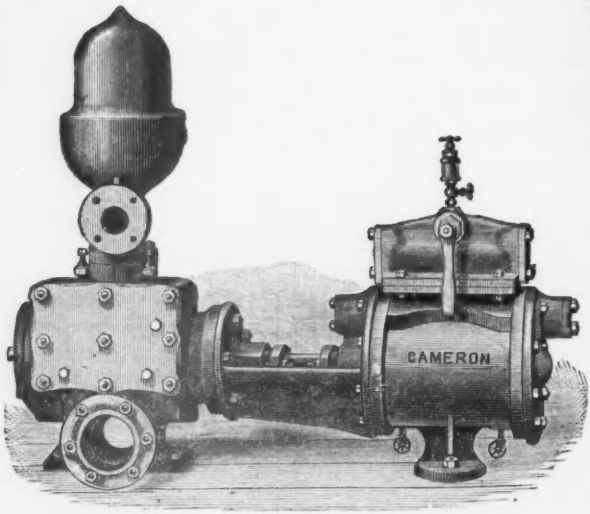

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THE MANHATTAN RUBBER MF'G CO.

CABLE ADDRESS "MIALOGIA"
TELEPHONE, 2965 CORTLANDT

Steam Packing,
Pump Valves,
Air Compressor Valves,
Rubber Belts,
Car Springs,
Gaskets,
Suction Hose,
Emery Wheels,

THE MANHATTAN RUBBER MFG. CO 64 CORTLANDT ST. N.Y.

FRANK CAZENOVE JONES,
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ALL KINDS OF MECHANICAL RUBBER GOODS.

Factories: Passaic, N. J. (on D. L. & W. R. R.)

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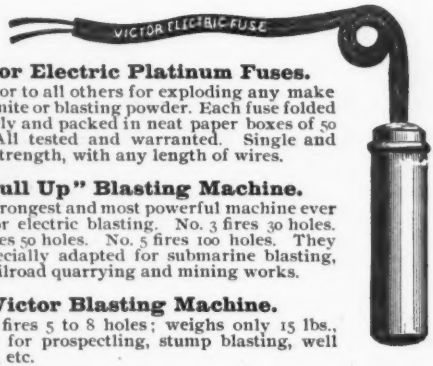
Electric Blasting.



Victor Electric Platinum Fuses.
Superior to all others for exploding any make of dynamite or blasting powder. Each fuse folded separately and packed in neat paper boxes of 50 each. All tested and warranted. Single and double strength, with any length of wires.

"Pull Up" Blasting Machine.
The strongest and most powerful machine ever made for electric blasting. No. 3 fires 30 holes. No. 4 fires 50 holes. No. 5 fires 100 holes. They are especially adapted for submarine blasting, large railroad quarrying and mining works.

Victor Blasting Machine.
No. 1 fires 5 to 8 holes; weighs only 15 lbs., adapted for prospectling, stump blasting, well sinking, etc.

STANDARD ELECTRIC FUSE AND BLAST TESTER, WIRE REELS (New Design), LEADING AND CONNECTING WIRE.

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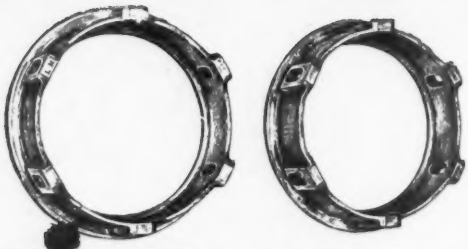
The Piston Inlet Air Compressors.



Valves after five years of hard use.

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Anaconda Mining Co.
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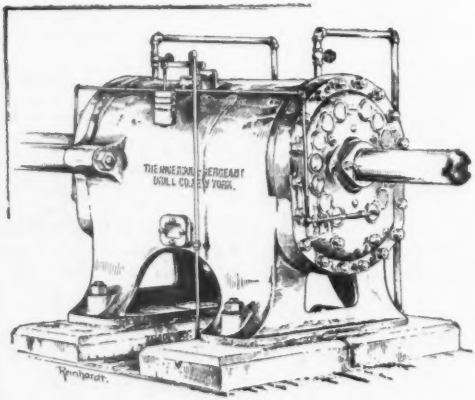
And shops of every description.



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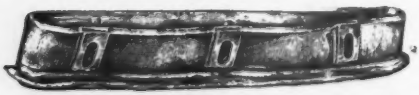
Automatic Unloading Device.
Water Jacketed.
Efficient Cooling.
Minimum Clearance.
Simplicity.

High Duty Compressors, Straight Line, Half Duplex and Duplex.

Effect of Steam Hammer on a Piston Inlet Valve.



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